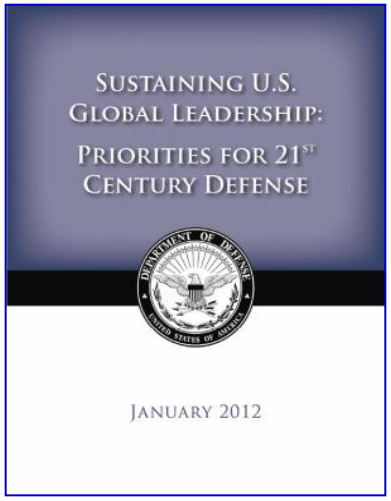
Science & Technology Challenges for the Asia-Pacific Region

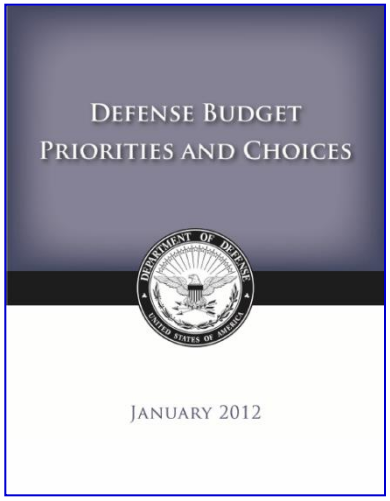
22 October 2013

Al Shaffer

Assistant Secretary of Defense for Research and Engineering (Acting)

Key Elements of Defense Strategic Guidance



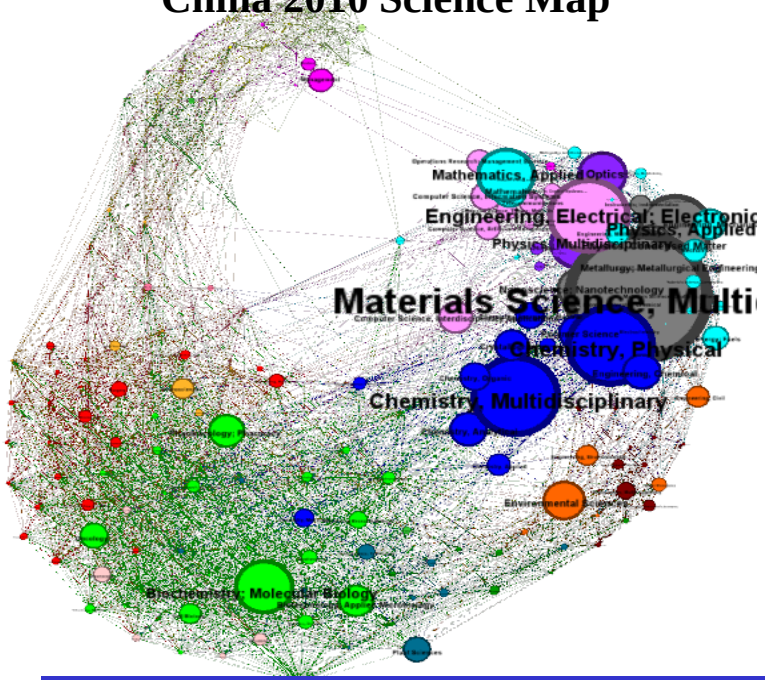


- **The military will be smaller and leaner, but it will be agile, flexible, ready and technologically advanced.**
- **Rebalance our global posture and presence to emphasize Asia-Pacific regions.**
- **Build innovative partnerships and strengthen key alliances and partnerships elsewhere in the world.**
- **Ensure that we can quickly confront and defeat aggression from any adversary – anytime, anywhere.**
- **Protect and prioritize key investments in technology and new capabilities, as well as our capacity to grow, adapt and mobilize as needed.**

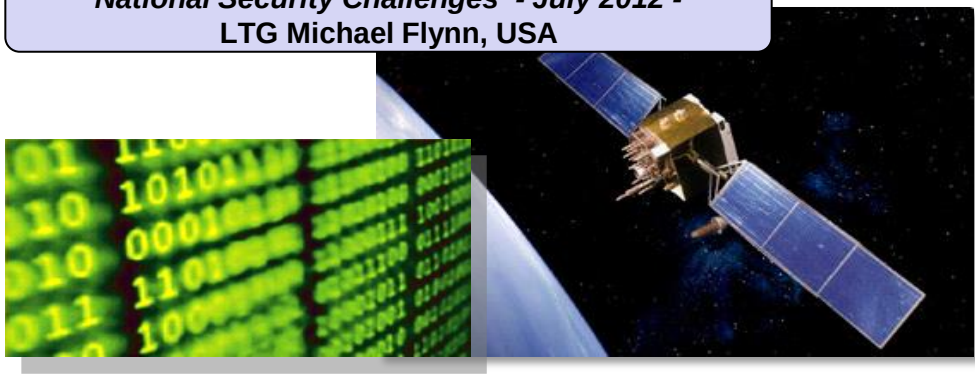
Complexities of Our National Security Environment

- **Global environment is ever changing and uncertain**
- **Future is hard to predict**

China 2010 Science Map



National Security Challenges - July 2012 -
LTG Michael Flynn, USA



- **Spread of free markets and open societies has accelerated globalization**
- **Our next conflict could be an unconventional conflict against a highly asymmetrical threat**

Ability to Operate in the Commons will be Critical

“(Ladies and) Gentlemen, we are out of money.

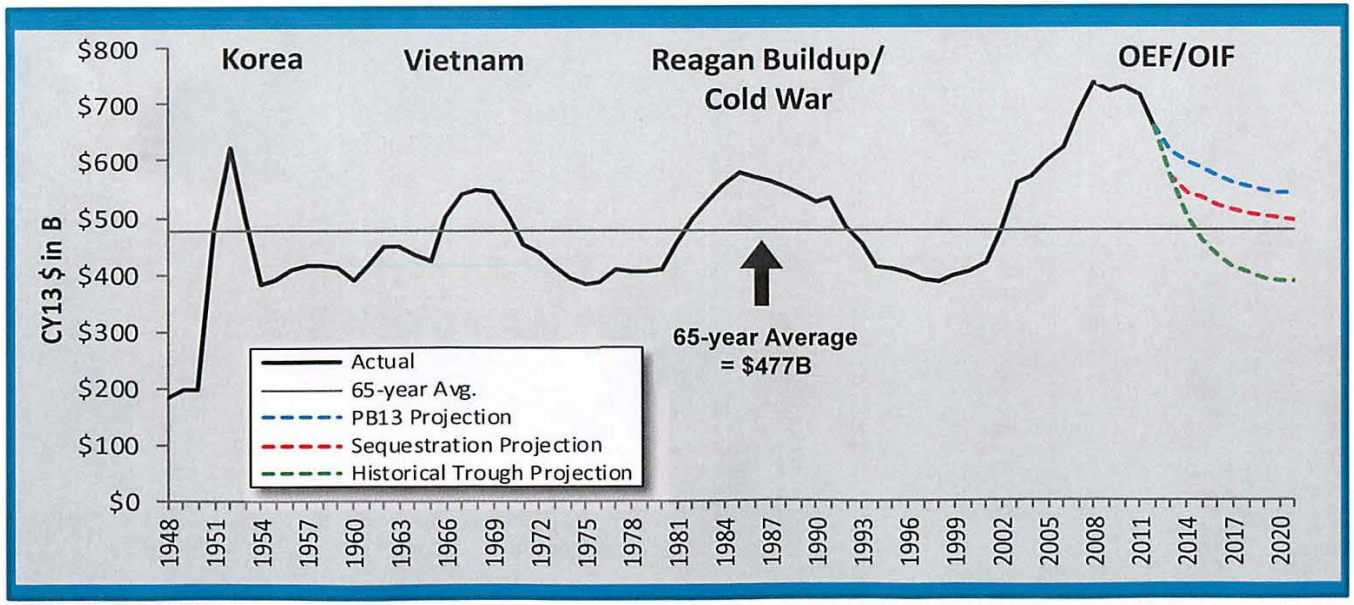
Now we must think!”

Winston Churchill to
Parliament during World War II
(Stolen from Ernest Rutherford)

The Reality….

"Our current security challenges are more formidable and complex than those we faced in downturns following Korea, Vietnam, and the Cold War. There is no foreseeable "peace dividend" on our horizon."

GEN DEMPSEY, CJCS
Testimony to SASC, 12 Feb 2013



UNCLASSIFIED

Defense R&E Strategy

"Protect and prioritize key investments in technology and new capabilities, as well as our capacity to grow, adapt and mobilize as needed."

-SECDEF, January 2012 Strategic Guidance

1. Mitigate new and emerging capabilities

- Electronic Warfare
- Cyber
- Counter Space
- Counter-WMD

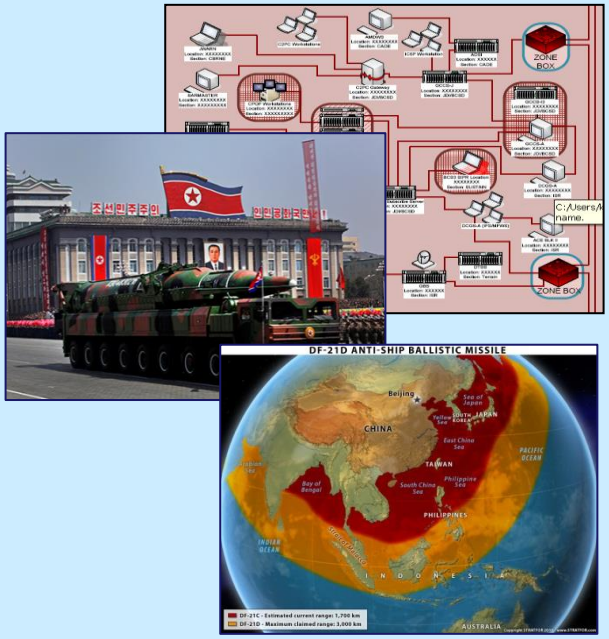
2. Affordably enable new or extended capabilities in existing military systems

- Systems Engineering
- Data Reuse
- Engineered Resilient Systems
- Developmental Test & Evaluation

3. Develop technology surprise through science and engineering

- Autonomy
- Basic Research
- Data-to-Decisions
- Human Systems

Technology Needs



- Middle East Instability
- North Korean Nuclear Ambitions
- Anti-Access/Area Denial
- Cyber Attacks
- Electronic Warfare

Prototypes

The Department can cost-effectively drive innovation in aviation, space, maritime and ground combat systems through prototyping

Proof of Concept:

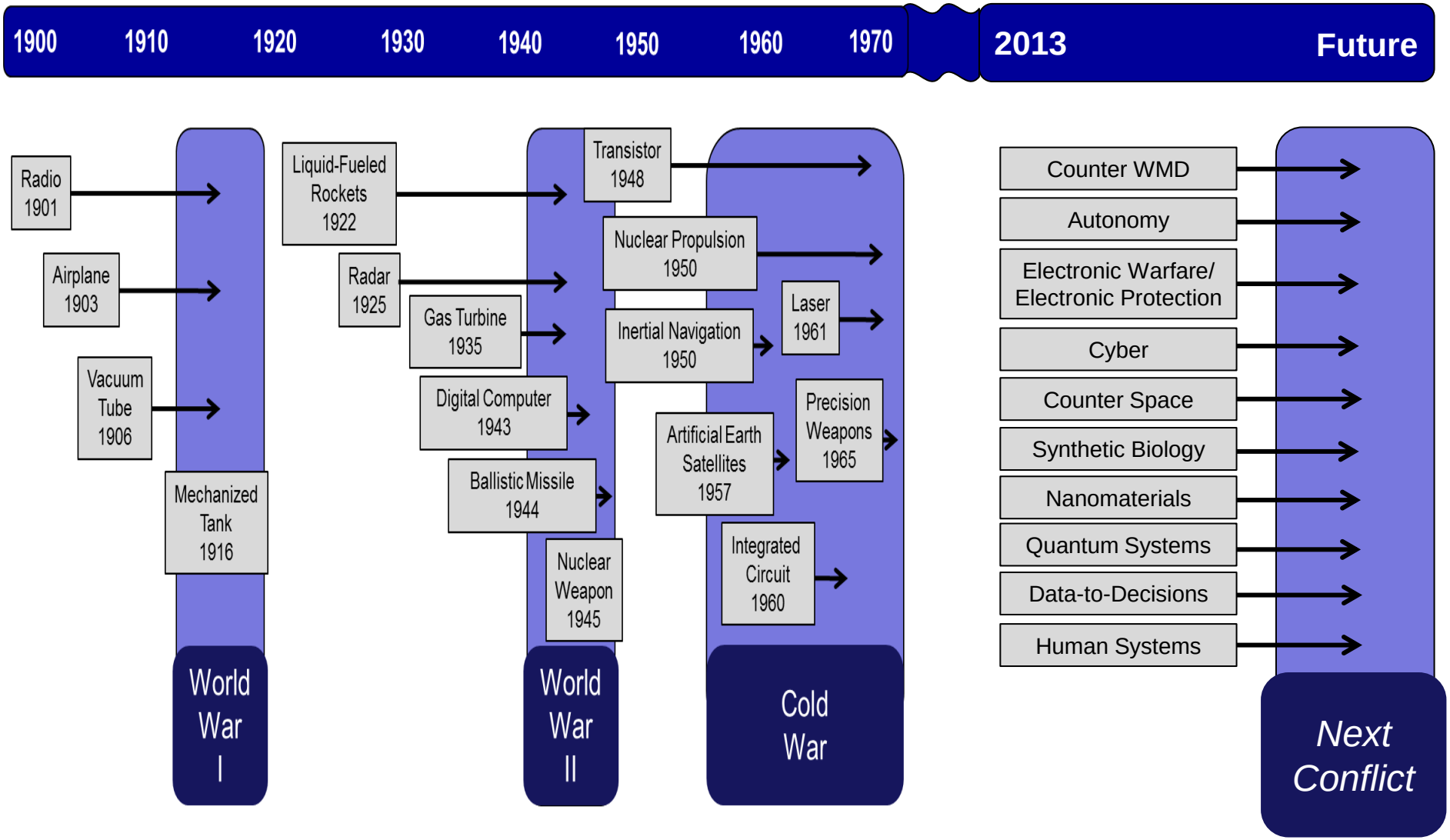
“X”- Plane Prototyping

Prototype Development Programs have expanded the state of the possible in military aviation without each necessarily driving a follow-on procurement activity





Lab Demo to Forcing Function:
Technology Investment Stocks Cupboard



A New Reality:
Global Dimensions Affect DoD S&T

Pace of Technology

Information Agility

Black Swan Syndrome

Technology Commercialization

Cloud Computing
skype
facebook
SECOND LIFE
WIKIPEDIA
myspace.com
a place for friends
del.icio.us
WiFi
digg
YouTube
flickr
twitter

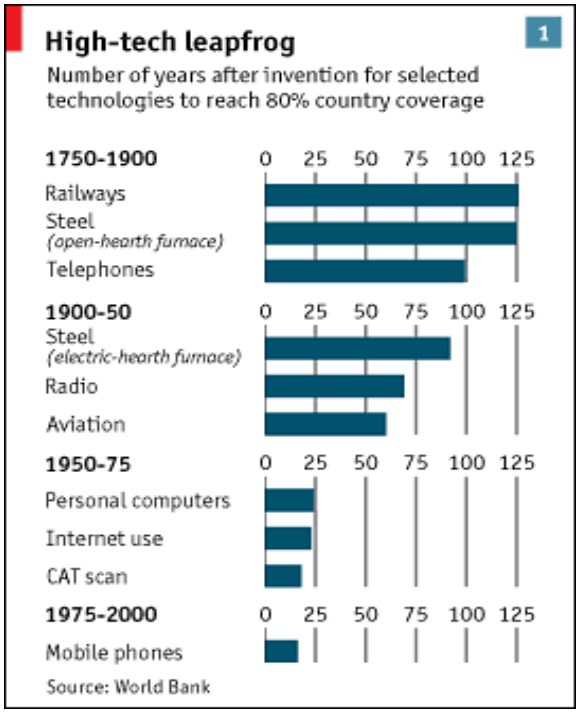
Expanding Global Knowledge Base

Economic and S&T Mega-Trends

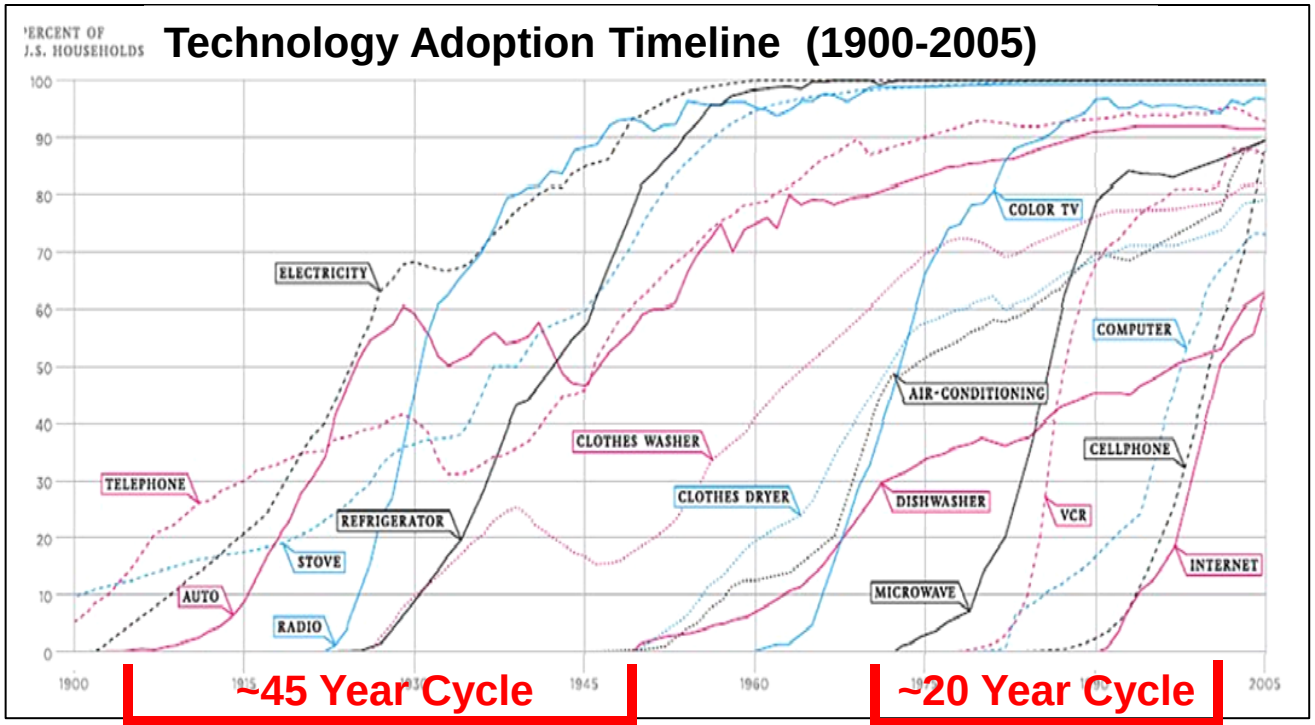
Rise of the Commons

Mass Collaboration

Pace of Technology



The Economist, Feb. 9, 2008



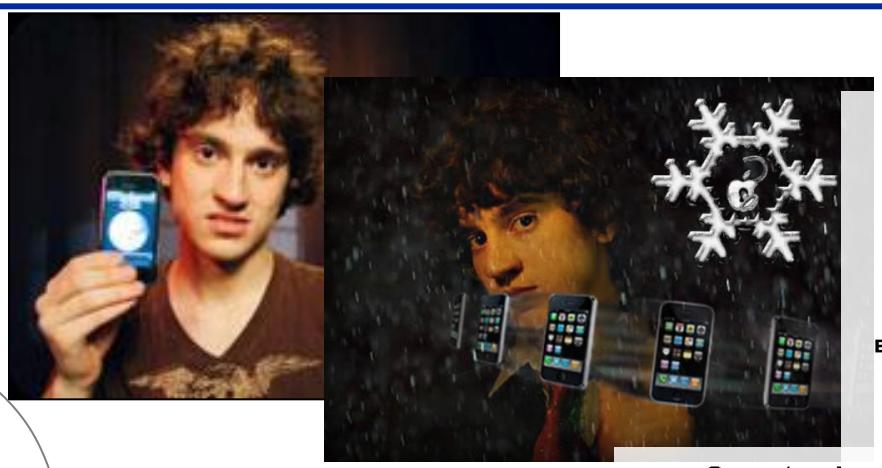
It took 23 years to go from modeling germanium semiconductor properties to a commercial product

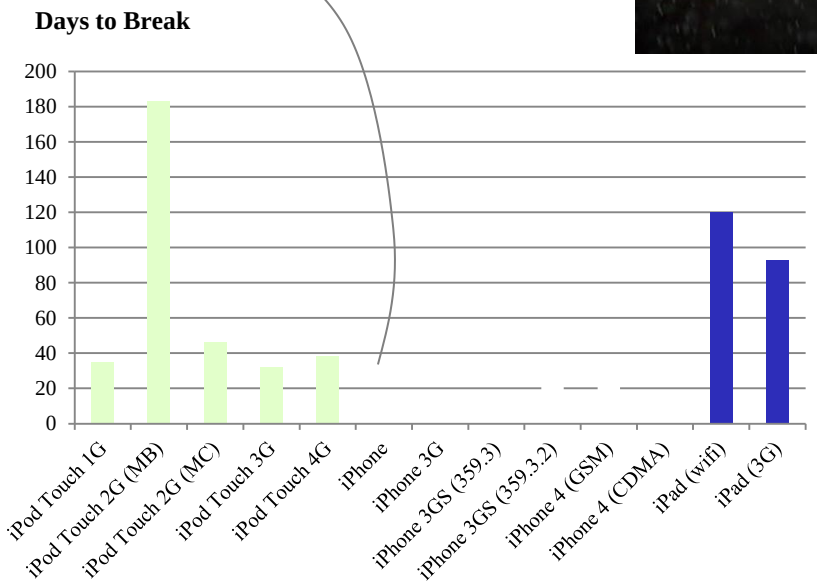
The carbon nanotube was discovered in 1991; recognized as an excellent source of field-emitting electrons in 1995, and commercialized in 2000

The Pace of Technology Development and Market Availability is Exceeding the Pace of Acquisition

Information Agility

Apple and AT&T released the iPhone on 29 June in an exclusive agreement. Hotz spent ~500 hours working on his "summer project" and the hack was available in July.

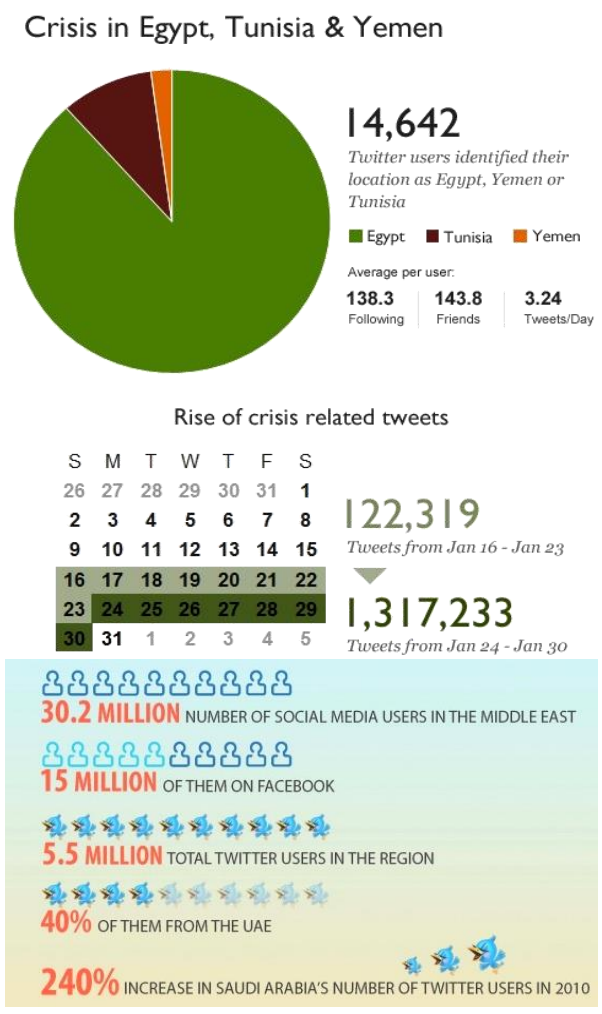


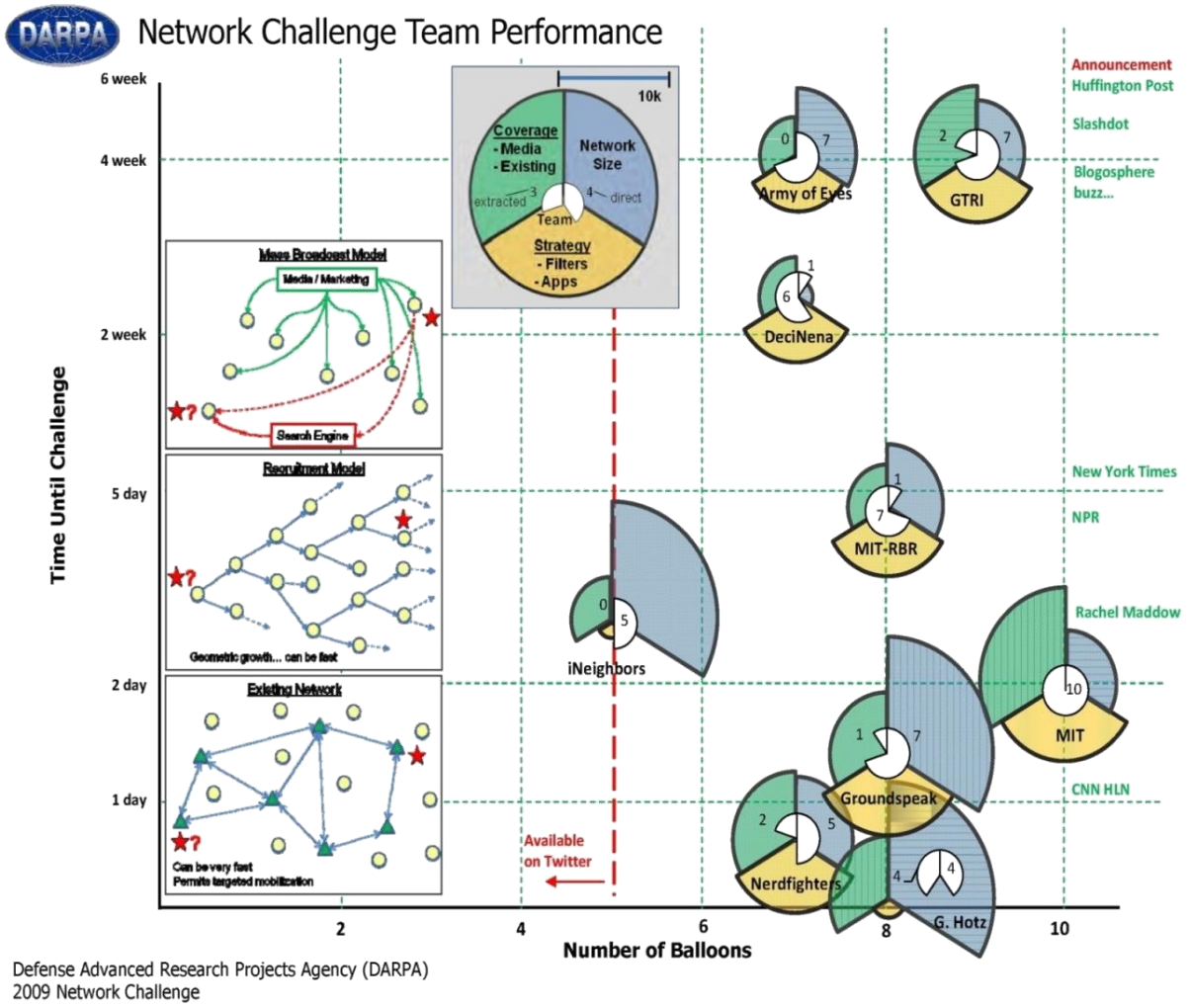


Today's adversaries are light and agile, and rapidly react and innovate in response to US actions.

This is the New Asymmetry—Victory Goes to the Agile and Innovative

Mass Collaboration



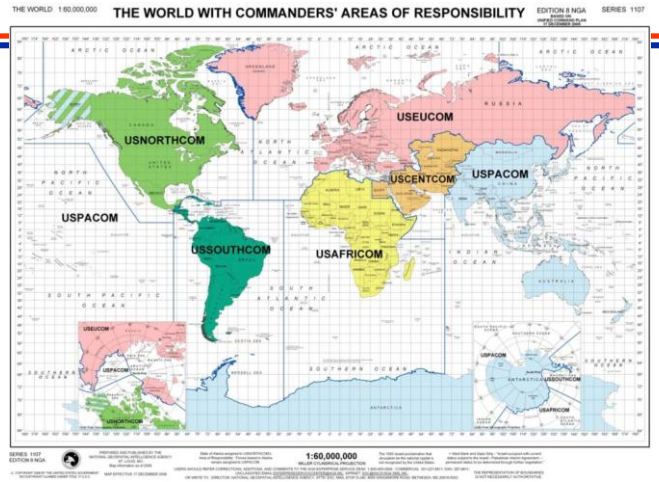


Defense Advanced Research Projects Agency (DARPA)
2009 Network Challenge

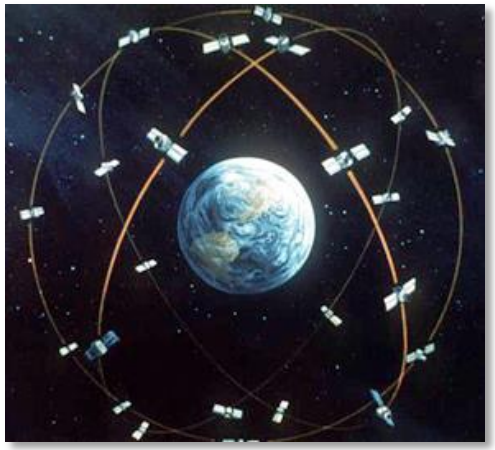
Ad-hoc Groups Can Quickly Solve (or Create) Massively-Complex Problems

Rise of the Commons

Electronic Warfare

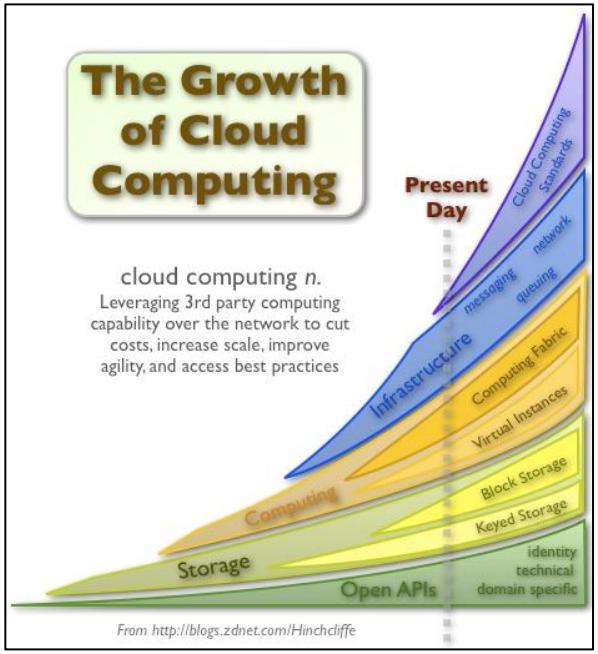


Oceans



Space

Cyber

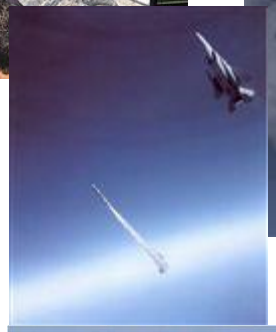


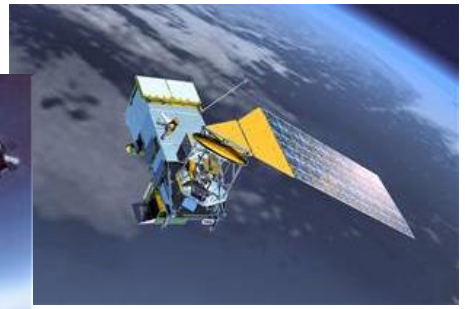
Ubiquitous Data

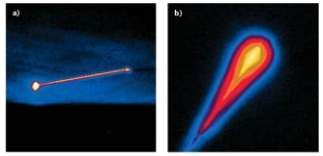
Military Operations Increasingly Depend on Being Able to Operate in Places "No One Owns" – *The Enablers*

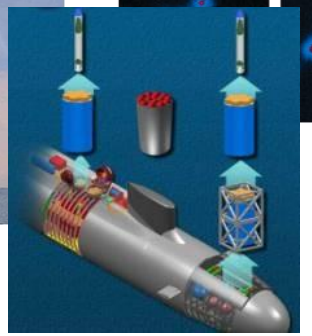
Anti-Access/ Area Denial
Current A2/AD Priorities

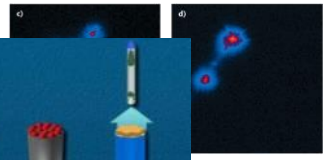
- Electronic Attack / Electronic Protection
- Cyber Operations
- Space / Counter Space
- Undersea Operations
- Counter Missile / Missile Defense
- Counter Integrated Air Defense Systems







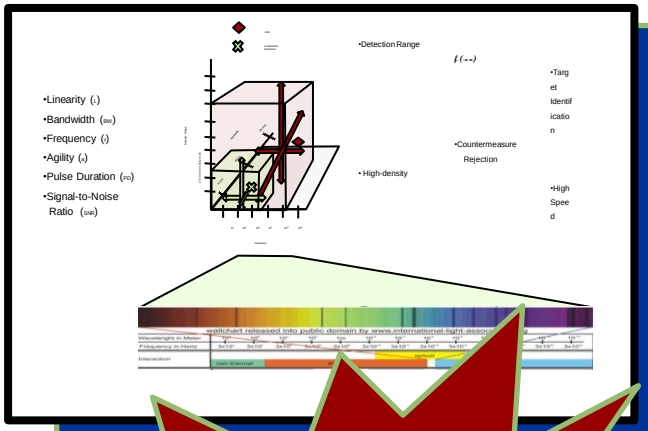




Electronic Warfare

U.S. EW Superiority is Being Broadly Challenged

- Digital signal processing expanding
- Threat systems more lethal, longer range, mobile
- Sensors are networked and active – passive combinations are appearing
- Radar and radio systems are trending to software-driven waveform generators
- Weapon seekers are more sophisticated with spectral diversity and ECCM processing
- Advanced jamming techniques and technologies are now available to adversaries



OPPORTUNITIES FOR NEW APPROACHES

Globally Accelerating Technology

Counter-Electronics HPM Advanced Missile Project (CHAMP) Joint Capability Technology Demonstration (JCTD)

- Extensive, joint RF test data base
- Narrowband HPM Advanced Counter Electronics Source (ACES) developed by AFRL HPM S&T
- Compact pulsed power system matured by AFRL, SNL, and industry
- Physics-based, supercomputing-enabled numerical simulation of HPM source & effects

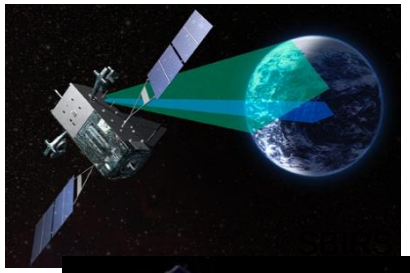
- **Sponsor: PACOM;**
- **Team: AFRL (lead) , Boeing, Sandia, Ktech**

Space and Cyberspace

From 2012 Chairman's Joint Operational Access Concept

- Space and cyberspace are increasingly important and contested domains with critical importance for the projection of military force.
- Future enemies will seek to contest space control and cyberspace superiority as means to denying operational access to U.S. joint forces.
- Gaining and maintaining space and cyberspace superiority will be a constant challenge

SATCOM



Missile Warning

PNT

GPS III

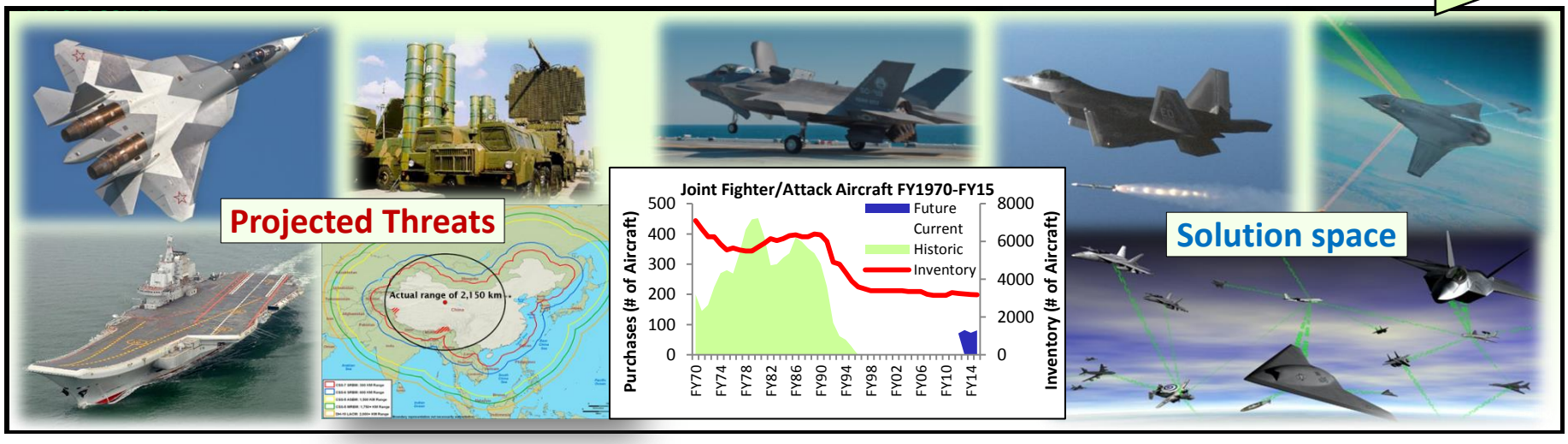
ISR

ORS-1

The current and future strategic environment is driven by three trends – space is becoming increasingly congested, contested, and competitive.
- 2011 National Security Space Strategy

System of Systems & Prototyping: Air Dominance Initiative (ADI)

What is our technology development plan for capability in 2020 – 2050 ?



Purpose

- OSD directed DARPA /USAF/USN technology game-plan to ensure Air Dominance through 2050
- Baseline our currently funded acquisition projects to ensure maximum integrated development; security umbrella put in place
- Identify high-payoff technology concepts
- Prototype those high risk technologies and determine which ones merit an acquisition program

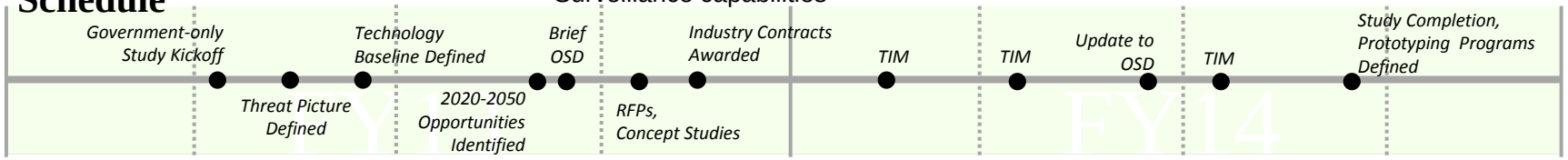
Key Technologies

- No single silver bullet program
- Systems approach to Air Dominance
- Next generation platforms
- Advanced networking capabilities
- Ensured, reliable navigation
- Passive and active system defense
- Electronic attack technologies
- Area denial capabilities
- Situational awareness technologies
- Cyber effects considerations
- Surveillance capabilities

Metrics

- Study completed in 18 months
- Maximum use of existing systems
- Cost of proposed concepts must be within available budgets
- Close integration coordination with focus on combined effects
- Prototype demonstrations completed within 5 years

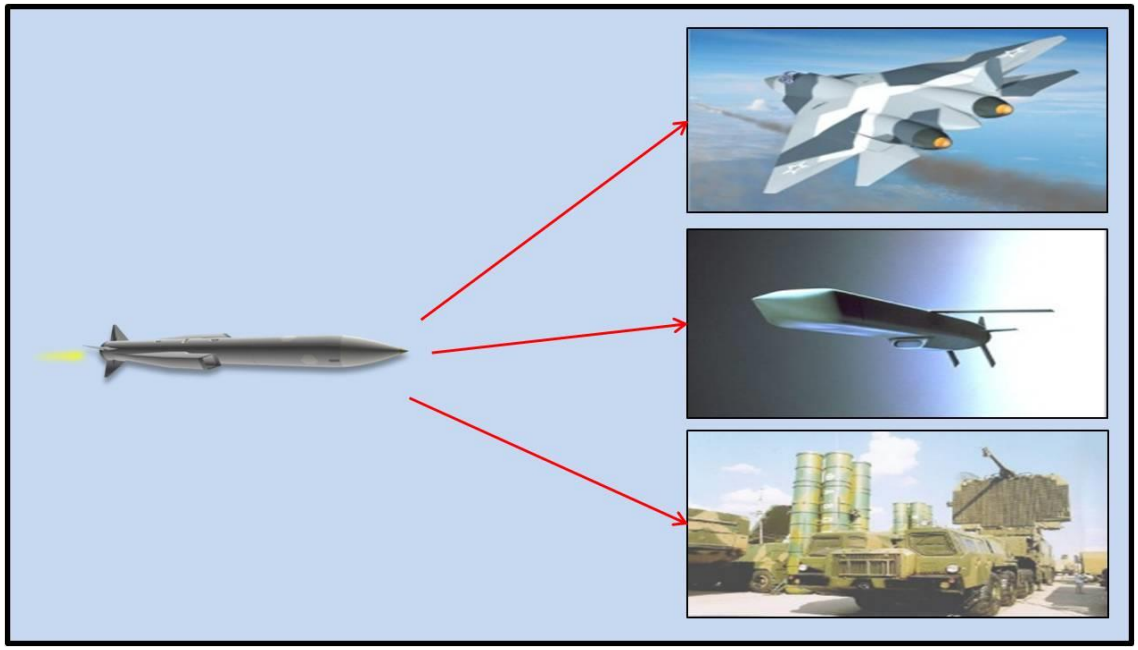
Schedule



Missile Demonstrators

DARPA/Navy Long Range Anti Ship Missile (LRASM)

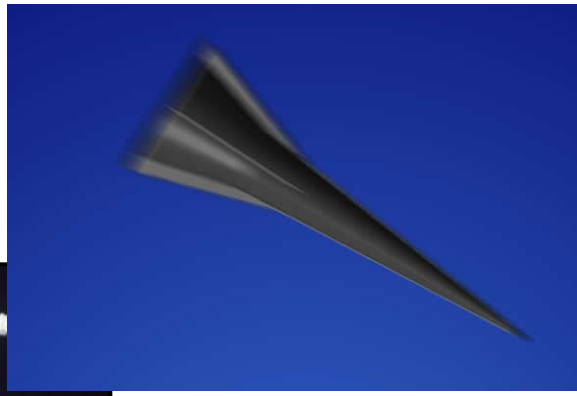
DARPA/AF Triple Target Terminator (T3)

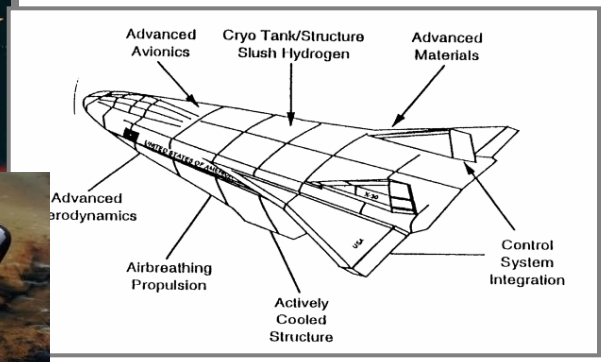


Photos courtesy NASA, Richard Hallion

Hypersonic Research … Turning the Corner

- **Successes**
  - X-15
  - Space Shuttle
  - X-43A
  - X-51A
  - Advanced Hypersonic Weapon (Nov 2011)





- **Did not meet goals**
  - Aerospace plane
  - NASP
  - X-33

Photos courtesy NASA, Richard Hallion

Summary

- **Asia-Pacific rebalance is the foundation of our R&E strategy**
- **DoD is working on advanced programs to enhance the ability to control the enablers**
- **A key is gaining control of the enablers.**